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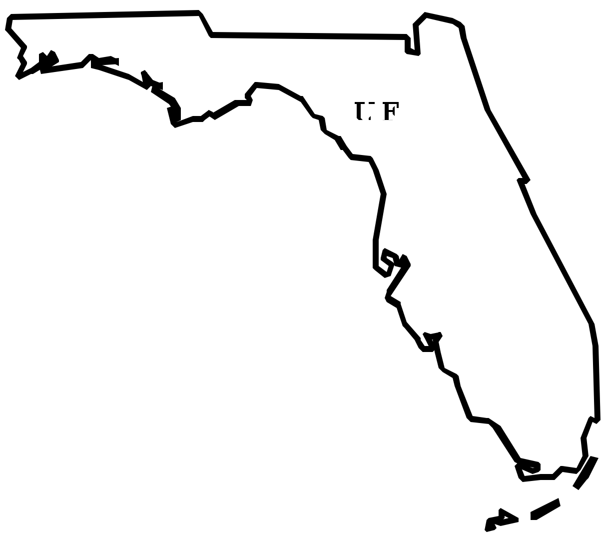

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Where is the Walrasian Auctioneer for Agricultural Markets? An Examination of the Marketing Institution

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Abstract: In the classical development of economic equilibrium and efficiency, transaction costs are seldom considered. This study develops a micro-market model of an agricultural market based on quality differences. The study then develops a model of market structure based on the New Theory of the Firm. Using the two models, we draw conclusions about economic potential for E-Commerce.

Keywords: E-Commerce, auction theory, institutions

1. Introduction

The evolution of a rigorous framework for microeconomic markets represents a major accomplishment of economic theory in the twentieth century. Mathematical proofs of the efficiency of the market can be found in a single market context in Samuelson (1947). Arrow and Debreu (1954) then extend the proof to demonstrate that the general equilibrium formed by including all goods yields a socially efficient allocation of goods. However, these advances tend to ignore a critical feature of the model. Specifically, they provide little discussion of the market itself. Most discussions rely on the existence of a mythical "Walrasian Auctioneer" that costly matches bids and quantities until the price vector balances the quantity supplied with the quantity demand. In reality, we know that

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markets are not costless. Selling any commodity involves direct and indirect costs. The direct costs are obvious. A grocery store incurs costs such as rent, wages, electricity, etc. However, indirect costs may prove more significant. Indirect costs may appear as simple extensions of direct cost. For example, a grocer's cost may include the opportunity cost of shelf-space instead of an allocated rental cost. From the buyer's vantage point, the search cost may be significant. For example, in Akerlof's (1970) discussion the buyer balances the search cost for a camera with the anticipated gain of finding a lower price. The potential significance of these costs is startling because they exist within a well-defined consumer channel. This paper examines the implications of these transaction costs within the context of agricultural markets by comparing the market structure for grain crops and livestock in the United States. The local elevator dominates the farmer market for grain in the United States. The farmer sells grain by delivering it to a local elevator at a quoted price. This price is typically based on a national price for grain (such as wheat in Kansas City or Galveston, Texas) plus an adjustment for quality less transportation and handling. The only auction is whether the farmer chooses to transfer title to the grain at the stated price. This system can be contrasted with the historical reliance of livestock producers on auctions. In this marketing channel, the price of animals is determined by the interaction of several buyers with the seller. While the buyer may base his bid on a national market and transaction cost, there is *a priori* understanding. In this paper, we argue that this result is consistent with indirect transaction cost implied by information. It is our further contention that since both the direct transaction costs and indirect transaction costs are functions of technology, that the market structure is dynamic.

This paper is divided into four sections. In the first section, we provide a brief review of the economic theory of auctions. The second section then develops a theoretical model to explain the choice of market structure based on informational content. Specifically, we hypothesize two potential market structures. In the first structure, information on the quality of a good is objectively discernable while in the second structure information is less objective. Finally, the fourth section of the manuscript examines the potential for vertical integration. Following the New Institutional Economics literature, the balance between transaction costs and diseconomies of scope determines the degree of vertical integration. The form of market institution directly affects the transaction costs. Thus, because of increased uncertainty in quality, markets with higher transactions costs should embody relatively more vertical integration. This section also examines the role of a new technology. The emergence of a new technology may significantly reduce the transaction cost, yielding a more highly integrated marketing channel.

2. Economic Theory of Auctions

Milgrom (1989) presents an overview of auctions and bidding. He traces the theoretical development of auction theory to the work of Vickrey (1961). This early work developed the conditions under which an auction would yield an equilibrium willingness to pay and typically contrasted several alternative forms of auction mechanisms. Specifically, the theoretical literature compares the pricing derived from an oral English auction (where bidding starts from a low price and successive bids reveal that buyers are willing to pay more), an oral Dutch auction (where bidding starts at a high price and the auctioneer decreases the price until a buyer is willing to pay the stated price), and various sealed bid strategies. Most of this literature suggests that each auction yields similar final prices.

Another facet of auction theory is the "winner's curse." The winner's curse grows out of the assumption that each potential buyer's bid is based on a Bayesian probability density function. Under this scenario, the agent with the winning bid may be the one that possesses the least information regarding the value of contract. Specifically as stated by Milgrom "Even though each contractor's individual bid is unbiased (that is, equal on average to the expected cost), the lowest bid is biased downward." (p. 5)

3. Information and Market Structure

Following the traditional abstraction, a market is composed of a supply curve which represents the quantity of a homogeneous good that will be offered for sale by numerous producers at any given price and the demand curve which represents the quantity of the homogeneous goods that will be purchased by numerous consumers at any given price. Market equilibrium is the price-quantity combination that equates the total quantity supplied by producers with the total quantity demanded by consumers. The consistency of the observed market with economic theory is a matter of perspective. One could assume that the demand for grain at the local elevator is perfectly elastic. Specifically, we could assume that the local elevator could sell any quantity of grain at the national price less transportation cost. Similarly, if we assume that the quantity of cattle offered for sale in a pen is perfectly inelastic, then the market price generated by the competition between buyers is consistent with the typical market story.

As a starting point, assume that the value of the commodity to the buyer, V, is a function of some attribute, x. Next, we assume that x is not perfectly observable, but has an imperfect observable measure, v. Defining the error in observation as ε, the value of the commodity to the buyer can be defined as

$$E\left[V(x)\right] = E\left[V(v-e)\right] \quad (1)$$

where E[.] is the expectation operator. Given this formulation, there are two ways to value the commodity based on the uncertainty with regard to quality. The first is to assume risk aversion. Following the general approach of Pratt (1964), the expected value becomes

$$E\left[V(v-e)\right] = V(v) + \tfrac{1}{2} V''(v) s_e^2 + o\left(e^3\right) \quad (2)$$

where $V''(v)$ is the second derivative of the value function at v, s_e^2 is the variance of the quality measure, and $o(e^3)$ is a third order approximation error. Under risk aversion, the market price declines as the uncertainty increases. A second assumption would be that lower than expected quality imposes some cost on the seller while higher than expected quality has no direct payoff. In the case of the wheat market, wet grain would impose additional drying cost on the elevator while dry grain does not yield a premium.

To make comparisons between the markets, we assume that the measurement error is a function of technology. Mathematically, we assume

$$\begin{gathered} E[V(v-e)] = V(v) + \tfrac{1}{2} V''(v) s_e^2(T) \\ \text{where } \frac{\partial s_e^2(T)}{\partial T} \leq 0 \end{gathered} \quad (3)$$

where T is the level of technology. Thus, as technology improves the buyer is better able to ascertain the quality of the product and the relative value for any observed level of quality increases.

Letting $E[V(v\text{-}e)]$ be the market price, p, and $V(v)$ be some index price, p^I, the market equilibrium condition becomes

$$D\left(p^I + f\left(s_e^2(T)\right)\right) - S\left(p^I + f\left(s_e^2(T)\right)\right) = 0 \quad (4)$$

where $D(.)$ is the consumer's demand function and $S(.)$ is the producer's supply function. The market price is then determined by supply and demand conditions in the local market and the measurement error. Intuitively, as the measurement error increases the price discount relative to the market index increases, even though the local market continues to clear.

The differences in local markets then grows out of the shape and content of $f\left(s_e^2\right)$. Expanding the market demand and supply equilibrium in equation (4) to include the possibility of multiple buyers and sellers

$$\sum_{i=1}^{N_D} D_i\left(p^I + f_i\left(s_e^2\right)\right) - \sum_{i=1}^{N_S} S_i\left(p^*\right) = 0 \quad (5)$$

where $f_i\left(s_e^2\right)$ denotes the measurement error of each individual buyer and p^* denotes the market clearing price offered to all sellers. The quantity of commodity purchased by each seller is then a function of his or her respective measurement error. The relatively larger the measurement error, the smaller the consumer surplus generated by the buyer.

In this system sellers prefer either the elimination of measurement error, or an increase in the number of buyers. Naturally, as the measurement error declines then p^* approaches p^I. The result of an increased number of sellers can be justified if we assume that measurement error is a random function. Thus, as the number of sellers increases the probability of one seller possessing a lower measurement error increases. This produces the same result as the winner's curse from auction theory. However, we assume that risk averse buyers will not bid the full market price under quality uncertainty. Thus, instead of the winner's bid being biased downward, as the sample grows in this model the winner's bid approaches the true market value since the measurement error declines.

The question of auction versus administered prices within this overall framework depends on the cost of each mechanism. Even as the measurement error approaches zero, the seller is still better off with a larger number of buyers. In order for administered prices or pricing rules to be preferred by the sellers, we must introduce a marketing cost. The net margin to each marketing mechanism based on the measurement error problem can be defined as

$$p = \left[\sum_{i=1}^{N_D} D_i\left(p^i + f_i\left(s_e^2(T)\right)\right)\right] p^* - C\left(N_D\right) \quad (6)$$

where $C(N_D)$ is the cost of developing a mechanism with N_D buyers. These costs may include either direct cost, such as yardage and transportation in the case of livestock, or opportunity cost, such as the time value of money in waiting for the next auction.

Differentiating equation (6) with respect to the number of buyers would yield the optimum number of buyers. Administered pricing would be optimal if the optimal number of buyers is less than or equal to one. Mathematically, let

$$D^*\left(N_D\right) = \sum_{i=1}^{N_D} D_i\left(p^I + f_i\left(s_e^2(T)\right)\right). \quad (7)$$

Then differentiating (6) with respect to the number of buyers yields

$$\frac{\partial p}{\partial N_D} = \frac{\partial D\left(N_D\right)}{\partial N_D} - \frac{\partial C\left(N_D\right)}{\partial N_D}. \quad (8)$$

Based on the model development, we assume that $\partial D^*\left(N_D\right)/\partial N_D > 0$ and $\partial C\left(N_D\right)/\partial N_D > 0$ [1]. Given that the optimal demand is less that or equal to one

$$\left.\frac{\partial D^*\left(N_D\right)}{\partial N_D}\right|_{N_D=1} - \left.\frac{\partial C\left(N_D\right)}{\partial N_D}\right|_{N_D=1} \leq 0 \quad (9)$$

with an equality if the optimum number of buyers is one. If the optimum number of buyers is less than one we are left with two possibilities. First, the market supports a non-zero quantity. This implies that the profit in equation (6) is positive with zero buyers. Second, the market is not economically feasible which is indicated by a nonpositive profit in equation (6) with zero buyers. If either the optimal number of buyers is one or if the optimal number of buyers is less than one, but the market yields a positive profit, the optimal number of buyers is one and the system degenerates to an administered pricing system.

In this case, the marginal value of an additional bidder is small because of the accuracy of measurement. However, also embedded in this formulation is the choice between using larger, central, livestock auctions or local auctions. Undoubtedly, the

[1] Taking the second assumption first, we assume that it is costly to bring another buyer into the market. This may imply such simple assumptions as the cost of building a larger auction barn, the cost of verifying buyer credit, etc. The assumption regarding the return to the marginal buyer is slightly more problematic. First, we assume that the buyer's demand curve is nonnegative and downward sloping. Thus, for any buyer *i*

$$D_i\left(p^I + f_i\left(s_e^2\left(T\right)\right)\right) \geq 0 .$$

This must also hold for the last buyer (N_D). The problem then becomes one of ordering. If all the buyers have an identical demand curve, the issue is the ordering of $f_i\left(s_e^2\left(T\right)\right)$. Without loss of generality, we can order these in ascending order

$$f_1\left(s_e^2\left(T\right)\right) \leq f_2\left(s_e^2\left(T\right)\right) \leq \cdots f_{ND}\left(s_e^2\left(T\right)\right)$$

which implies that the last buyer yields the smallest amount of information. Combining these two results, the last buyer will have a nonnegative demand for the output such that the overall change declines as the number of buyers increases. The last buyer added has the largest measurement error and, hence, the smallest demand if all buyers have identical demand functions.

larger auctions imply a smaller measurement error. However, the cost of obtaining this premium may be more than offset by increased transportation costs.

4. Transaction Costs, Auctions and the Internet

Recent developments in the theory of the firm by Williamson (1975), Grossman and Hart (1986) and others have extended Coase's (1937) original framework by attempting to describe vertical integration with transaction costs. In this framework, the institutional structures of firms are determined by balancing potential diseconomies of scope against transaction costs. The diseconomies of scope are implicit in the difficulties of managing large entities and grow out of the separation of management from operations (the number of levels to the factory floor), internal rent seeking by middle management, etc. Transaction costs may be the result of a variety of factors. In Coase and Williamson, transaction costs may result from market power and limited information. Grossman and Hart come to a similar transaction cost, but cite relationship specific investments. In the current study, we offer a slightly different perspective on the new theory of the firm. Specifically, we examine the role of the theory of the firm in the development of a marketing channel.

As a starting point, we present two extremes in the organization of a marketing channel. The first scenario is a completely centralized marketing channel as embodied by the formerly centrally planned economy. In this channel, a single entity controls all the decisions regarding the production, distribution, and pricing of a single good. At the other extreme, we hypothesize a completely atomistic market where different economic agents control each transformation (either transformation by production or transportation). At this level the potential gains to institutional change are apparent.

Both market organizations may be sluggish in reaction. The centrally planned organization may suffer from difficulties in internal control. On the other hand, each atomistic unit may adjust readily, but several transactions may be required to transmit production and distribution signals through the channel. In each case, we could hypothesize that the inefficient institution could be replaced by an alternative organization that resulted in less organizational cost (the sum of transaction cost plus diseconomies of scale).

Thus, in the centrally planned economy, the single market entity could be challenged by a market structure with two firms one that focused on production and the other that focused on distribution and marketing while the atomistic structure may be challenged by an alternative market structure that involved integration between transportation and marketing. In fact, both changes in market structure were observed during the nineteenth and twentieth centuries. During the nineteenth century, atomistic firms in the areas of oil, steel, and railroads experienced significant centralization, although some of the pressure toward centralization was driven by imperfect competition. On the other hand, the age of the corporate conglomerate came to an end in the 1980s and early 1990s as large corporations were purchased to be split up into smaller parts. (In the jargon of the day, the company's book value exceeded its stock value).

Factors such as the discrete nature of firms and the infrequency of firm sales suggest that any resulting market channel will not equate the marginal cost with the marginal benefit of organizational change exactly. In all likelihood, however, the marginal benefit (marginal gain of a structural reorganization less the marginal cost of an organization) will be less than the adjustment cost. Thus, at any one point in time the market structure for a particular commodity will be stationary.

Two implications of the imperfect adjustment process for the market channels are that the current market structure will likely be path dependent and significant changes in the market structure may grow out of technological change. The path dependence of the market structure is based on the frictions introduced by past winners. One example of path dependence is when winning a past bid (Schumpeterian tournament) gives an advantage to the firm in a future tournament. Williamson discusses this facet of path dependence in the computer industry. While International Business Machines (IBM) had a dominant position in the market for mainframe computers during the 1970s, it lacked the incentive to introduce the Microcomputer (even though it had the technology). The introduction of the Microcomputer would significantly affect its existing market for mainframes. However, once another company introduced the Microcomputer, IBM found it advantageous to challenge the entrant in the new market. In the marketing channel scenario, a past winner may already have an advantage through sunk costs such as granaries, warehouses, etc. Thus, the next structure of the vertical channel will most likely include major players from the current structure.

A basic factor that could cause changes in the marketing channel is technological change. In the Coasian framework, technological change could affect the boundaries of the firm either by changing the diseconomies of scope or transaction costs. If the technological change made it possible to manage a more diverse business structure, it could reduce the diseconomies of scale and, thus, yield pressure towards integration. However, a technological change that reduced the cost of transmitting information (bids) could reduce the transaction costs and decrease the degree of integration. In either case, the total amount of processing would remain unchanged, but the agent doing the processing would change.

This reallocation of processing is the primary interest of this study. In the past, farmers have relied on local elevators to set the market, arrange transportation for grain, and provide storage. A change in relative information may cause one or more of these roles to be retained by the farmer. Specifically, a technological innovation may either decrease the economies of scale or transaction cost leading the farmer to do the actual marketing function. The elevator may still provide storage and arrange transportation, but the farmer may enter into a contract for delivery.

Such a change may be the ultimate result of the Internet and E-Commerce. Internet posting of offer prices for grain at terminal or grain mills could result in more direct farmer marketing. Linking this scenario with the auction model presented in the preceding section, the advent of E-Commerce may provide an alternative (challenger) to the current market structure. Specifically, E-Commerce may make it possible to bring more buyers and sellers together which would yield a reduced measurement error. The reduction in measurement error implies higher producer surplus.

5. Conclusions

The economic theory of the efficiency of markets has been well established. However, this theory typically does not address the exact market mechanisms. Specifically, in the case of agricultural markets several firms are involved in the marketing channel from the farm to the consumer. Several factors within this market channel can have significant impacts on market efficiency and the allocation of economic rents. This study briefly reviews the economic theory of auctions and then constructs an alternative model for determining the number of bidders in a given market based on the information on quality. Building on the theory of the micro-market, we then examine the question of institutional change within the marketing channel. Following the New Theory of the Firm as proposed by Coase, Williamson and Grossman and Hart, we conclude that technological innovations will change vertical integration in the channel if it reduces transaction cost relative to the diseconomies of scope. The advent of the Internet has the potential for such realignment.

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